

# URBAN AND REGIONAL POLICY

*Project Work: Developing a  
Sustainable Urban Mobility Plan  
for  
Erode City, India*



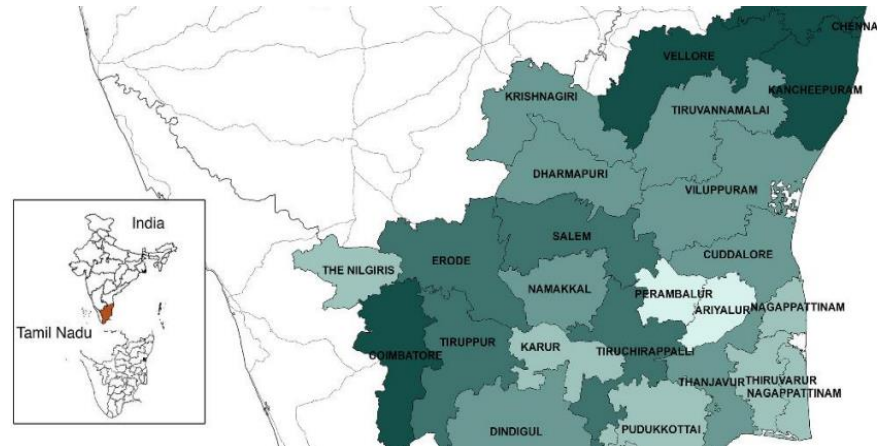
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## EXERCISE-1. BUILDING KNOWLEDGE ABOUT ERODE

- The total area of the city is **109.52 km<sup>2</sup>** (with addition of extended areas in 2011, ECMC's area went up from **8.44 sq. km. to 109.52 sq. km.**). It has also been selected for Smart City Development Programme by the ministry of urban development. Heavy traffic congestion is main problem in the city because of its poor infrastructure for non motorised transport. It has a population of **2,251,744** people, where 1,195,773 people were working. The density of the city is **397/km<sup>2</sup>**. It also has 1621 schools and 52 colleges within the city. The total population of school and college students are 236,000. It is one of the prominent trade centers in the state which normally faces traffic congestion.
- Erode is one of the most important cities of Tamil Nadu and it is the administrative headquarters of the Erode district. The city is located on the banks of River kaveri and known for its power loom and hand loom products. Due to the abundance of the textile business, Erode is also known as the 'Loom City' or "Textile City" of India. It is one of the most important business centers of South India. There are a number of government educational institutions present in Erode. Erode was a part of the Coimbatore District and was separated in the year 1979. The city is well connected by roads and several state highways like SH-15, SH-37, SH-84 and SH-84A are some of the important highways that pass through the city. The nearest airport is Coimbatore Airport which flies both domestic and international flights.
- Erode is one of the most literate places in India and the average literacy rate of the city is 84.99%. Economy of Erode is dominated by textile industry, oil industry and the turmeric industry and there are two large industrial estates in the city. Karur, Dharapuram and Chennimalai are the main hubs of Textile industry of Erode. Carpet manufacturing industry and leather processing are other highlights of the economy of Erode. Coconut oil and turmeric production, printing presses are some other important industries of Erode. Erode is a very important business center of South India and that is why many people come to erode for business purposes.

# ERODE CITY



Geographical Area (Sq. Km.)

Erode

4%

Other

Population (2011)

Erode

3%

Other districts



# TRANSPORTATION IN ERODE

## Road Network

- The LPA has a total road network of 1100 km., comprising of arterials, sub-arterials and major local streets. The city road network constitutes 300 kms. The arterial network includes National Highways (NHs), State highways (SHs) connecting Erode with major places in the district, State and neighboring states, form about 180 kms.

## Bus Transport

- Erode has an efficient public bus transport system. Tamil Nadu State Transport Corporation (TNSTC) provides long distance as well as city/mofussil bus services in Erode. The city/mofussil bus fleet strength is 153 (TNSTC- 106, private- 47), and operates about 1640 services daily. Its city/mofussil bus operation covers 112 routes covering major roads in the LPA. there are private buses (both normal and mini buses operated by private operators). The total number of daily trips made by bus in the LPA area is 3.23 lakhs, in which 1.73 lakhs is made within the city.

## IPT Transport

- The Intermediate Public Transport (IPT) modes include normal auto rickshaws and shared auto rickshaws (few nos.) mainly serving the LPA. Totally there are about 5000 auto rickshaws in the city area; however the utilization is very low (about 5% of trips). Main reason for lower utilization is its high fare, as IPT operation is not organized.

## Private Transport

- Popular personalized modes of transport are two wheelers and cars. As on 31st March 2013, total number of registered vehicles in the LPA area is 4.51 lakhs, which is growing at about 7% per annum. 85% of the total registered vehicles are two wheelers.

## Goods Transport

- The number of goods vehicles registered in Erode is 17,925 as on 31st March 2013. About 19, 000 goods vehicles enter and leave the city daily (trucks and MAVs constitute 5,000). The average share of goods vehicles in the city traffic during peak hour is about 8%.

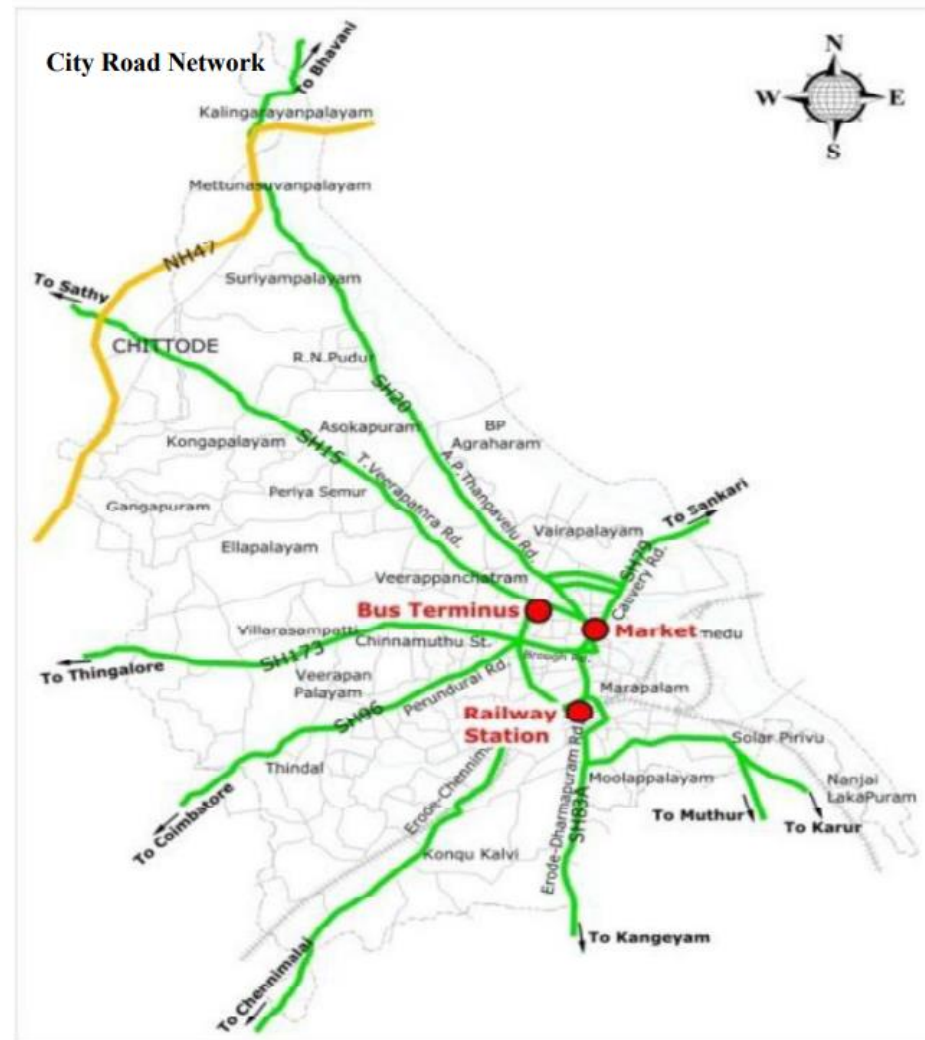
## Railway Network

- Erode is a major railway junction of Southern Railways with two rail lines passing through (Jolarpettai-Morappur-Salem-Erode-Tirupur-Coimbatore line and Erode- Karur line). Passenger trains are plying towards Salem, Tirupur and Karur. However, the share of trips made in LPA by rail is found to be very minimal.

## LPA- Local Planning Area, TNSTC- Tamil Nadu State Transport Corporation



# ROAD NETWORK AND RAILWAY NETWORK



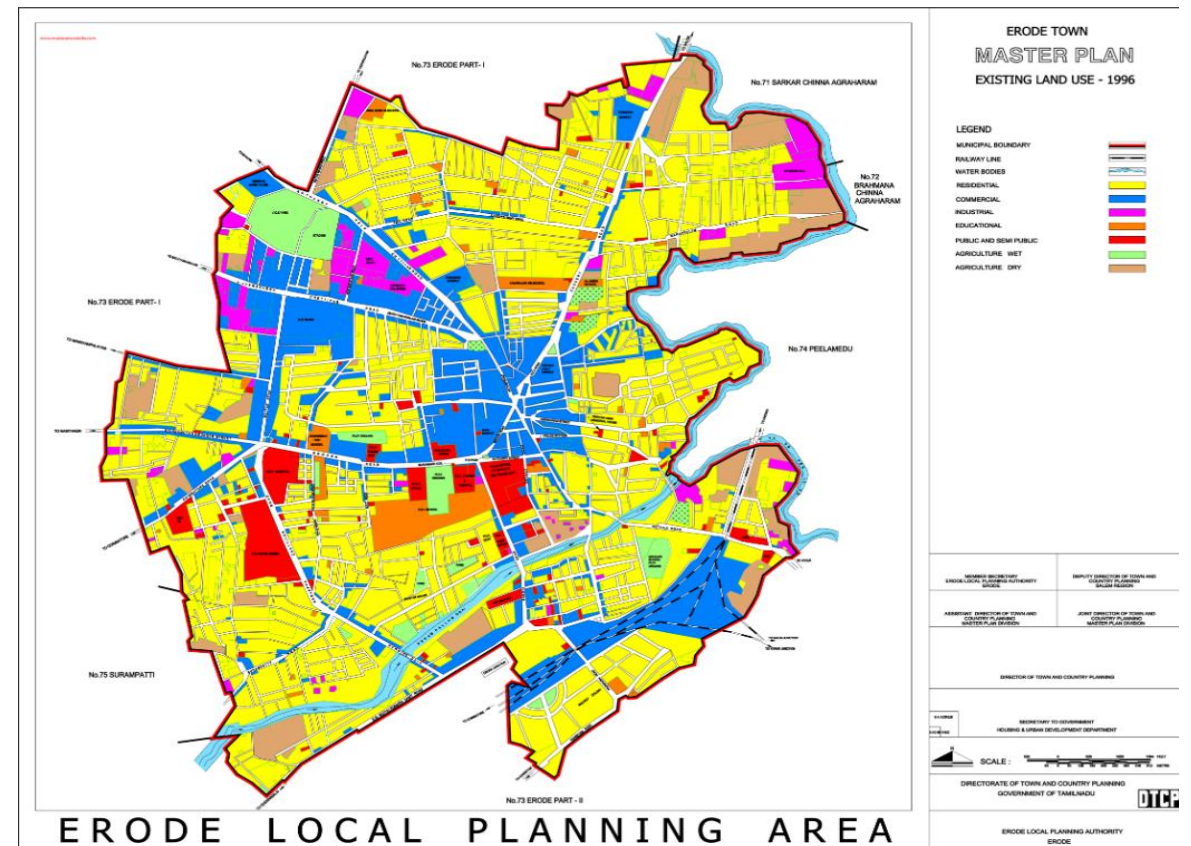
# LAND USE

To achieve an orderly physical development, to have a concomitant land uses and to ensure a congenital eco system six land use classifications they are.

- Residential use
- Commercial use
- Industrial use
- Educational use
- Public & semi public use
- Agricultural use

Land use area around 8.44 Sq.KM (Local planning Area-1996) and it has been extended to 109.52 Sq.KM on the year 2011.

**ECMC-Erode City Municipal Corporation**



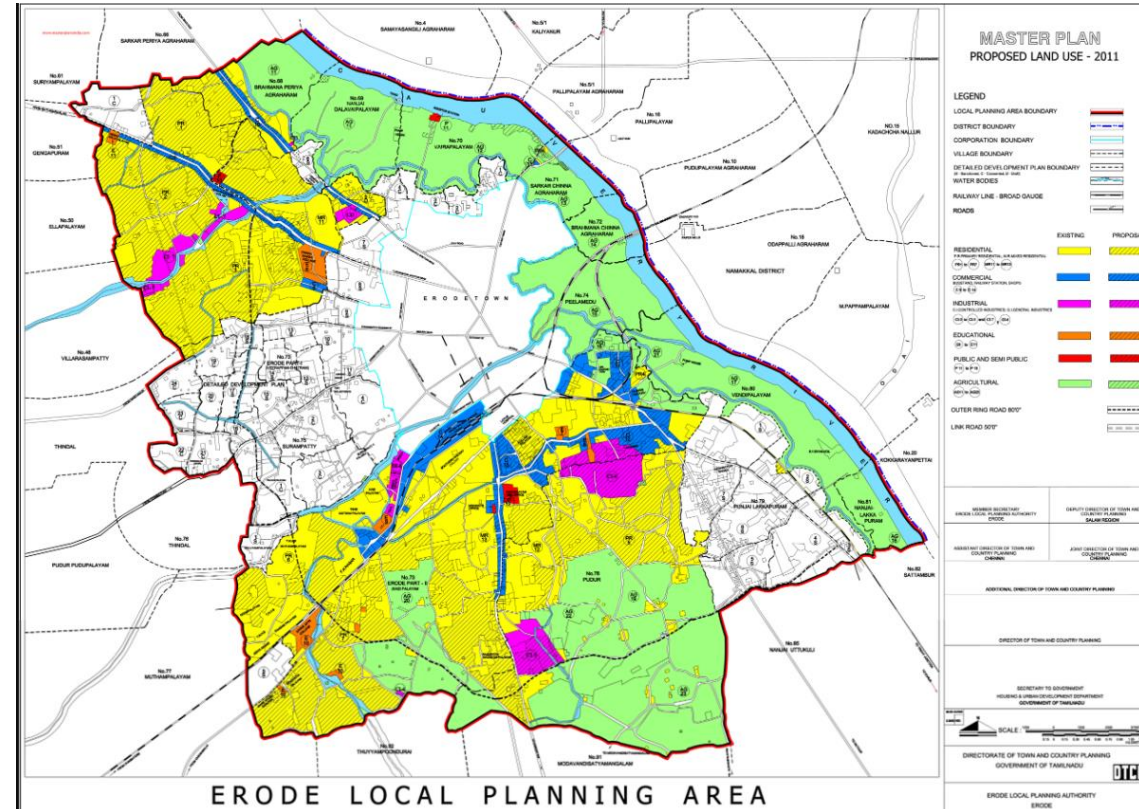
# LAND USE AND RELATED PROBLEMS OF ERODE

- Increase of population growth leads to lack of transport infrastructure, traffic congestion and increase of transport emission in city centers.
- Footpath is generally absent in the city
- Pedestrian signals & crossing facilities are absent.
- The share of bicycle trips is 7%. However, exclusive lane for bicycles is absent. Cycle path is mandatory on urban roads as per National Urban Transport Policy.
- There are about eighty major intersections in the LPA, (twenty eight in the city and forty six in the rest of LPA), in which thirteen are signalized. However, these junctions are not grade separated, causing traffic delay and pollution. Cycle time at many signalized junctions is above 120 sec. and has high traffic during peak hours. Junctions lack markings, signage and pedestrian crossing facilities.
- Designated on-street parking is absent in Erode. Parking demand is high in the city core area, with total parking demand of about 900 PCE/HR (Parking Car Equivalent). Maximum demand is observed for two wheelers (75%), followed by Car (10%). Unauthorized and indiscriminate parking impedes free flow of traffic and causes accidents.
- Critical accidents spots due to High speed of vehicles, absence of lighting facilities and inadequate signage and markings.

# MASTER PLAN OF ERODE CITY

- Preparation of Master Plans in Tamil Nadu is handled under the Department of Town and Country Planning (DTCP) which operates under the Housing and Urban Development Department.
- In addition to the Master Plan, 58 Detailed Development Plans were also prepared for select regions within this area. However, with addition of extended areas in 2011, ECMC's area went up from **8.44 sq. km. to 109.52 sq. km.** Parts of ECMC (Gengapuram, Suriyampalam etc.) thus extended beyond the boundaries of the erstwhile Erode LPA into the Chithode New Town Development Authority limit.
- This situation was corrected in June 2013, under which the LPA area was expanded to include the entire area under ECMC, villages under Perundurai, area under the erstwhile Chithode New Town Development Authority and 26 villages from Non-Plan area.

## ECMC- Erode City Municipal Corporation





# MASTER PLAN OF ERODE CITY

**Need, Necessity and Importance for Preparation of Erode Master Transportation Plan i.e, Comprehensive Mobility Plan (CMP) is prepared as per the toolkit formulated by Ministry of Urban Development, Govt. of India (MoUD):**

Erode is as a major transport hub in the western part of Tamil Nadu and facilitates the mobility needs of the region. Erode requires a CMP due to:

- Its upgradation to City Corporation in 2011 with an area expansion more than ten times, without planning for the transport infrastructure and the city is facing challenges due to urban sprawl.
- Encourage the sustainable modes of transport as the city lack pedestrian and cyclist facilities,
- Discourage personal modes of transport, thereby reduce congestion, pollution and increase travel safety
- Identify proper on street and off street parking areas which helps in the effective use of road space, reduce congestion and pollution levels.
- Transportation system planned for Erode should be able to meet social, economic and environmental sustainability goals. This can be achieved through a proper CMP
- CMP ensure a quick, affordable, safe, reliable, comfortable, energy efficient and environmentally sustainable systems
- CMP will be the tool to guide sustainable growth of the transport sector, by implementing the plans in a timely manner.
- The CMP vision for transport in Erode LPA is that an integrated approach towards the transport services and systems for Erode to promote sustainable urban transport infrastructure through various projects, including policies and planning, public transport systems and goods delivery networks, NMT facilities, land use, with a view to provide safe, affordable and efficient transportation, with focus on energy efficiency, reduction in pollution, and congestion, controlling urban sprawl by considering the regional and National importance of Erode.

# EXERCISE:2 BUILDING KNOWLEDGE TO PREPARE WELL

- In order to define the more convenient for Erode, worldcities tool website was used. <http://www.worldciestool.org/>
- F.U.As - Functional Urban Areas & U.Cs – Urban Centers
- As a Result to focus on Functional Urban Areas.

Erode	Population	
	U.Cs	F.U.As
1975	923816	984549
1990	1190620	1291159
2000	1304022	1442903
2015	1355557	1582499

Erode	Build Up Area (Square KM)	
	U.Cs	F.U.As
1975	20.09	21.12
1990	36.4	38.75
2000	50.66	55.14
2015	62.69	71.77

Erode	Build Up Area per Capita (M2 per capita)	
	U.Cs	F.U.As
1975	21.75	21.45
1990	30.57	30.02
2000	38.85	38.21
2015	46.25	45.35

Erode	Population Growth.	
	U.Cs	F.U.As
1975-2015	0.96%	1.19%
1990-2015	0.52%	0.62%
2000-2015	0.26%	0.62%

Erode	Build UP Area Growth	
	U.Cs	F.U.As
1975-2015	2.89%	3.11%
1990-2015	2.20%	2.50%
2000-2015	1.43%	1.77%

Erode	Build Up Area per Capita Growth	
	U.Cs	F.U.As
1975-2015	1.90%	1.89%
1990-2015	1.67%	1.66%
2000-2015	1.17%	1.15%

# BUILDING KNOWLEDGE TO PREPARE WELL

- Some graphs with related variables and datas of Erode between the years of 1975 and 2015 have been obtained from the Urban Centre Database of the Global Human Settlement Layer website of the European Commission.

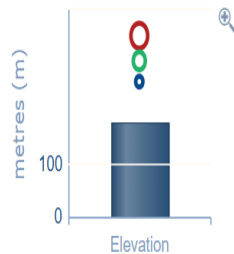
**Biome types:** Tropical and Subtropical Dry Broadleaf Forests

**Climate classes:** Steppe (semi-arid), and Hot arid

**Main river basins:** Cauvery River

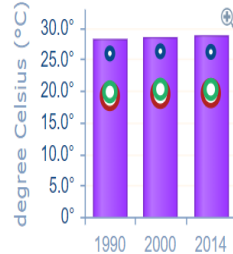
**Soil groups:** Luvisols

**Elevation**



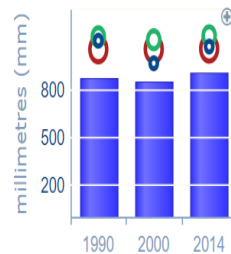
Mean elevation of the Urban Centre (metres)

**Temperature**



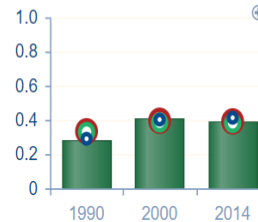
Average temperature (degree Celsius)

**Precipitation**



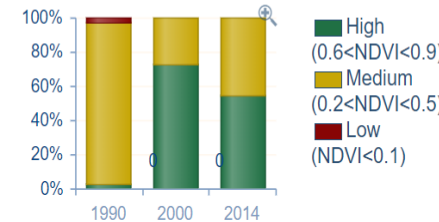
Annual precipitation (mm)

**NDVI**



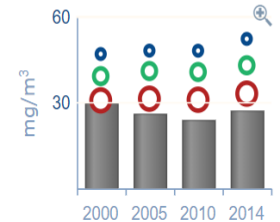
Amount of healthy vegetation in the city centre as estimated by the Normalized Difference Vegetation Index (NDVI)  
Unitless value in the range from

**Vegetated Surfaces**



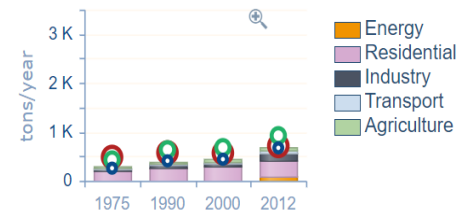
Share of surface by class of Normalized Difference Vegetation Index (NDVI)

**PM 2.5 Concentration**



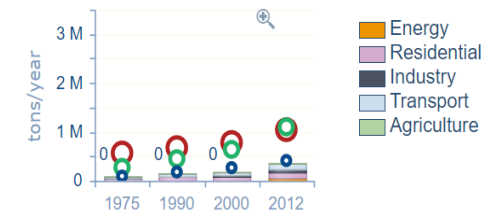
Fine Particulate Matter<sub>2.5</sub> concentration (mg/m<sup>3</sup>)

**PM2.5 emission**



Fine Particulate Matter<sub>2.5</sub> emission by sector (tons per year)

**Carbon dioxide (CO<sub>2</sub>) emission**



Annual CO<sub>2</sub> emission by sector per inhabitant (tons per person per year)

Averages for the attribute

- Global
- Regional (Asia)
- National

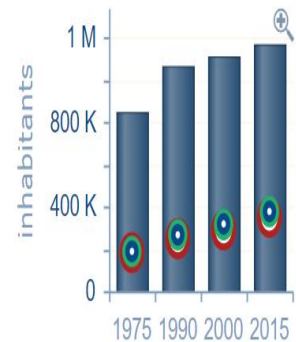
Averages for the attribute

- Global
- Regional (Asia)
- National

# BUILDING KNOWLEDGE TO PREPARE WELL

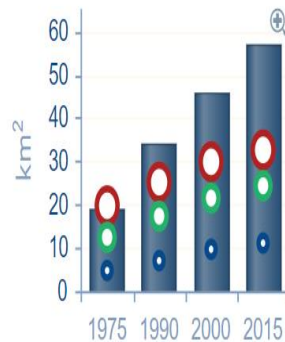
- From the year 1975-2015, Environmental Impacts due to increase of CO<sub>2</sub> emission, P.M 2.5 emission, temperature and vegetation surfaces decreased from the year 2000-2014. Increase of population growth and Build up area leads to traffic congestion.

Population



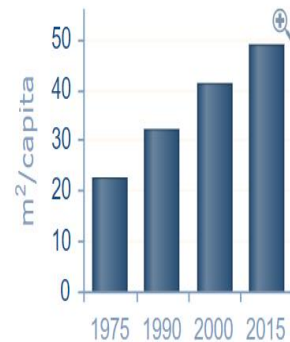
Total population

Built-up area (sq km)



Total built-up area

Built-up/capita (sq m)



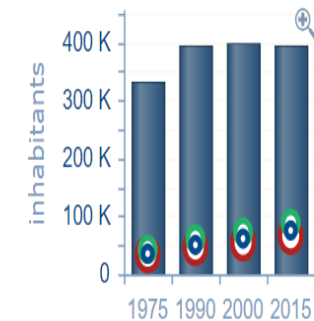
Built-up area (sq m) per capita

Heat Waves index



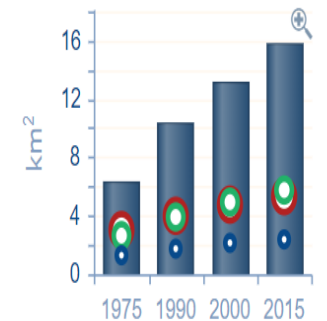
Maximum of the heatwave magnitude index (HWMId) observed during 1980-2010

Population exposed to floods



Population potentially exposed to floods considering a 100-year return period

Built-up exposed to floods



Built-up area potentially exposed to floods considering a 100-year return period (km²)



# PROBLEM DESCRIPTION

S.No	Problem Description	Problem Keywords	Land Transformation	Land Use (Dominant)	Scale
1.	Use of individual vehicles in urban transportation leads to Increase in traffic Congestion, CO2 emission, air and noise pollution and physical hazards.	Increase of personal mode of transport usage leads to increase of emissions, traffic congestions and physical hazards.	None	Mixed	Urban Area and City center
2.	Lack of green spaces, where footing path, bicycle path, pedestrian signals & crossing facilities are absent.	Lack of sustainable environment and city is facing challenges due to urban sprawl. The share of bicycle trips is 7%. However, exclusive lane for bicycles is absent. Cycle path is mandatory on urban roads as per National Urban Transport Policy.	Redevelopment and construction	Recreational	Neighbourhoods
3.	Lack of on-street and Off-street Parking areas, Designated on-street parking is absent in Erode	Parking demand is high in the city core area, with total parking demand of about 900 PCE/HR (Parking Car Equivalent). Maximum demand is observed for two wheelers (75%), followed by Car (10%). Unauthorized and indiscriminate parking impedes free flow of traffic and causes accidents.	Redevelopment	Mixed	Urban area and City center
4.	Unsafe public transportation, excessive transport operators		None	Mixed	Urban area and City center
5.	Accessibility problems for the physically challenged people or people with low-income level	Problem for physically challenged people and low-income people.	None	Not applicable	City center
6.	The inability to provide a fully integrated public transportation service and long dwell times and delays makes public transportation a time consuming activity and causes late arrivals	Lack of public transport integration	None	Transportation	Urban area and arterial to the city center

# CRITICAL LIST OF PROBLEM AND CRITICALITIES MATRIX

- The related problems of the city need to be analyzed under the quantitative point of view.
- The first issue of analysis is identifying problems in a clear way and it can be achieved by creating a Criticalities List.
- Secondly, a Criticalities Matrix should be created by relating problems identified in the previous list. This Criticalities Matrix can be used to interrelate problems to affected modes, types and relevance.
- The related problems of the city need to be analyzed under the quantitative point of view.
- The Criticalities Matrix should be filled with problem types and their corresponding weights of urgency as was given in the table below and all of the columns for each problem should be summed in order to understand if there are top priorities.

Type	Colour	Weight
Regulatory		1
Societal/Educational		6
Infrastructural		5
Operational		3
Environmental		4
Economic		2

CRITICALITIES MATRIX								
Mode		Problems and keywords						
		1	2	3	4	5	6	
		Use of individual vehicles in urban transportation leads to Increase in traffic Congestion, CO2 emission, air and noise pollution and physical hazards.	Lack of Green Spaces	Lack of on-street and Off-street Parking areas, Designated on-street parking is absent	Unsafe public transportation,excessive transport operators	Accessibility problems for the physically challenged people or people with low-income level	The inability to provide a fully integrated public transportation service and long dwell times and delays makes public transportation a time consuming activity and causes late arrivals	
Private	Commercial Vehicle	Economic losses due to congestion (e4+r1=5)		high prices for short parking time (e2+r1=3)				8
	Two Wheelers	Physical Hazards (I5+R1=6)		no reserved lots (r1+i5=6)	increased purchase of owned two wheelers	not common to use by people with low-income level	increase in use of PTW	19
	Passenger cars	Economic losses due to traffic congestion (e4+e2=6)		force to passenger cars to use unruled parking areas because of the lack of parking areas and/or high prices (i5+r1=6)		force to physically challenged people to buy and use their personal cars for those who are able to use it but also afford it (e4+e2=6)	increase in use of individual cars	23
Transit	Buses & mini buses	affected from congestion phenomena due to the increase in individual vehicles and no reserved bus-line (e4+r1=5)				(o3+r1=4)buses are not convenient for physically challenged people	unreliable schedules, delays and/or missing interchanges	12
	Railway	economic losses experienced by the suppliers due to the low number of passengers using public transport systems (o3+e2=5)				during peak hours, services are not convenient to use for physically challenged people	delays and/or missing interchanges due to bad connection with bus or metro services	14
Paratransit	Car Sharing			lack of enough parking lot (i5+o3=8)	Increases CO2 emission	only people with high income level can afford i t		14
	Taxi	affected from congestion phenomena due to the increase in individual vehicles and reduced efficiency (o3+e4=7)		increase in the use of taxi for those who can afford it due to parking problems		only people with high income level can afford i t	increase in use of taxi and operational problems due to overloading (o3+i5=8)	23
	Bike Sharing							4
Non motorized	Walking	health problems due to exhaust gases	people won't be encouraged to use active transport in a stressful/poor environment		compromised road safety	(e4+r1=5)walking paths should be more accessible and suitable for physically challenged people	long distances between transfer stations or long waiting times at stops (o3+i5=8)	23
	Bicycle						lack of cycling paths (or not completed) and the lack of integration	15
		42	10	25	16	27	35	Problem Scores

## EXERCISE-3 STRATEGY DEVELOPMENT

- According to the assessments, the most critical problems were determined as below

Rank.No	Problem Descriptions	Rank (Score)
1.	Use of individual vehicles in urban transportation leads to Increase in traffic Congestion, CO2 emission, air and noise pollution and physical hazards.- <b>42 score.</b>	
2.	The inability to provide a fully integrated public transportation service and long dwell times and delays makes public transportation a time consuming activity and causes late arrivals - <b>35 Score.</b>	
3.	Accessibility problems for the physically challenged people or people with low-income level - <b>27 Score.</b>	
4.	Lack of on-street and Off-street Parking areas, Designated on-street parking is absent in Erode. - <b>25 Score.</b>	
5.	Unsafe public transportation, excessive transport operators. – <b>16 Score.</b>	
6.	Lack of green spaces, where footing path, bicycle path, pedestrian signals & crossing facilities are absent. - <b>10 Score.</b>	
<ul style="list-style-type: none"><li>• These top 4 priorities (most critical problems) are located in several areas in the urban area and especially in the city center they have unplanned urbanization and high population comparison with other taluk of Erode.</li><li>• In order to do that, after deciding general problems, a matrix related to the type of problems and their impact fields was created.</li></ul>		



# STRATEGY DEVELOPMENT

Problem Macro Area		Impact field					
		Regulatory	Societal /educational	Infrastructural	Operational	Environmental	Economic
Congestion	Congestion-related delay	5,4		2	5,2	1	1
	Congestion-related unreliability			2,4	5,2		
Community Impacts	Community severance		3				3
	Visual intrusion					6	
	Lack of amenity	3	3	6			
Environmental Damages	Global warming			6		1,5	
	Local air pollution			6		1,5	
	Noise					1,5	
	Reduction of green space			6		6	
	Damage to environmentally sensitive sites					1	6
Poor Accessibility	Poor accessibility for those without a car and those with mobility impairments	3,4	3	2,4			3
Social and Geographical Disadvantages	Disproportionate disadvantaging of particular social or geographic groups		3				3
Safety	Number, severity and risk of accidents	5		1		1	4
Economic Growth	Suppression of the potential for economic activity in the area	4	5,3	2	2,4		4

# SELECTING THE OBJECTIVES TO START VISIONING

- After deciding the most critical problems of the city, these problems should be associated with suitable objectives in order to create a proper SUMP.
- For this case study of Erode, 8 different objectives were determined which are related to problems of the city and these objectives were listed below:
- Efficiency
- Accessibility
- Livable streets
- Protection of the Environment
- Social inclusion
- Safety
- Economic Growth
- Finance

# CONCEPT MAP OR MENTAL MAP

- In this concept map, the association between problems and objectives can be seen.

Problems		Use of Individual vehicles in urban transportation leads to increase in traffic congestion, air, noise pollution and physical hazards	Inability to provide a fully Integrated public transportation service and long dwell times and delays makes public transportation a time consuming activity and causes late arrivals	Acessibility problems for physically challenged people or people with low income	Lack of on-street and off street parking areas. Designated on-street parking is absent in erode	Unsafe Public transportation excessive transport operators	Lack of Green spaces	Objectives
Congestion	Congestion related safety	Encourage the use of public transport and Balanced development of all transport modes	Regulate the safety measures to reduce the physical hazards					Efficiency
	Congestion related unreliability	Increase funding for non-motorized modes	Regulate the time management and improve accessibility to integrated with other mode of transport		Regulate the parking facilities to reduce congestion in city centers	Regulate road public transport operation		
Community Impacts	Community severance	Increase walkways & bicycle lanes		Equity the mobility access	Increase the parking facilities			Accessibility
	Visual Intrusion							
	Lack of Amenity			Increase an easy access				
Environmental Damages	Global warming	Provide a stress free environment, Protect the personal health and Reduce Noise pollution and Transport emission					Increase green area in Urban	Liveable Streets
	Local Air Pollution					Reduce Transport emission		
	Noise							Protection of Environment
	Reduction of green Space							
	Damage to environment sensitive sites							
Poor Accessibility	poor accessibility for those without a car & those with mobility impairments		Encourage the non-motorized mode	Encourage the new Implement of transport to access for physically challenged people and low income people			Increase non-motorized transport mode	Social Inclusion
Social & Geographical Disadvantages	Disproportionate disadvantaging of particular social or geographic groups							Safety
Safety	Number, severity and risk of accidents	Reduce the usage of Individual modes to reduce the no.of accidents				Reduce number of accidents		Economic Growth
Economic Growth	Suppression of potential for economic activity in the		Maximize the fund to develop infrastructure to access for	Proper funding tn transport infrastructure for access of physically challenged	Allocate sufficient on-street and off-street parking facilities	Maximize funding for state owned transport mode	Proper funding for green spaces	Finance

## EXERCISE-4 DECIDING THE RIGHT MEASURES

- In order to decide the right measures, a decision support system was used which is called “Measure Option Generator” [www.konsult.leeds.ac.uk/mog/](http://www.konsult.leeds.ac.uk/mog/)

**Efficiency**; can be scored as 5. that can involve economic efficiency, service efficiency, environmental efficiency and traffic efficiency.

**Livable streets**; can be scored as 2, for the study case of Erode, Because Erode has selected in Ministry of Urban Development Government of India (MoUD).

**Protection of the environment**; can be scored as 4, it is an most important objectives for Erode since one of the most critical problem determined as the increase in traffic congestion, CO2 emission, air, noise pollution. where land use and urban sprawl are another important problems about environment in Erode.

**Equity and social inclusion**; can be scored as 3 since one of our most critical problems determined as the accessibility problems for the physically challenged people or people with low-income level.

**Safety**; can be scored as 3, it is an important objective in order to provide road safety and reduce the number of accidents.

**Economic growth**; can be scored as 2, because economic growth has low importance compared with other objectives.

**Finance**; can be scored as 4, it is more importance due to lack of sufficient facilities.

### Objectives ☒

- 5 ▾ Efficiency
- 2 ▾ Liveable streets
- 4 ▾ Protection of the environment
- 3 ▾ Equity and Social Inclusion
- 3 ▾ Safety
- 2 ▾ Economic Growth
- 4 ▾ Finance

### Any Strategy ☐

- 3 ▾ Reducing the need to travel
- 2 ▾ Reducing Car Use
- 4 ▾ Improving the Use of Road Space
- 5 ▾ Improving the use of Public Transport
- 5 ▾ Improving walking and cycling
- 2 ▾ Improving Freight



# DECIDING THE RIGHT MEASURES

- According to the previous selection, strategies should be assigned weights (0 to 5) as well, to indicate the relative importance of each strategy.
- For the case study of Erode, the strategies which have the highest importance to reduce the amount of emission. Accordingly, another important strategy is reducing car and two wheeler use which can improve the air quality and traffic problem in Erode.
- More Priorities in strategy, To improving the use of road space, Use of public transport, walking and cycling. It will leads to development of sustainable environment.
- After assigning weights to objectives and strategies, the Measure Option Generator generates a list below which shows all the policy measures within Konsult;

rank	measure	category	cost	timescale	score
1	Road user charging	Pricing	neutral	medium	46
2	Land use to support public transport	Land Use Measures	neutral	long	33
3	Development density and mix	Land Use Measures	high	long	24
4	Accident remedial measures	Management and service measures	medium	short	23
5	Pedestrian areas & routes	Infrastructure	medium	medium	22
6	Intelligent transport systems	Management and service measures	medium	medium	20
7	Regulatory restrictions	Management and service measures	low	short	19
8	Parking charges	Pricing	neutral	short	19
9	School travel plans	Attitudinal and behavioural measures	low	short	17
10	Cycle networks	Infrastructure	medium	medium	17
11	Parking standards	Land Use Measures	low	long	16
12	Parking controls	Management and service measures	low	short	16
13	Urban traffic control	Management and service measures	medium	medium	15
14	Bus regulation	Management and service measures	neutral	medium	15

# DECIDING THE RIGHT MEASURES

In order to create a measure package, packages and synergy methods were selected and implemented.

- The size of the package was selected as 5. Also, the first 10 measures with the highest scores were selected in order to create the package.
- According to the scores, the combination of all type of possible packages which composed by 5 measures can be seen in the table below.
- In this study, the first ranked combination was chosen to be the only one to focus on

Rank	Measure1	Measure2	Measure3	Measure4	Measure5	Score
1	Cycle networks	Accident remedial measures	Road user charging	Pedestrian areas & routes	Land use to support public transport	32
2	Development density and mix	Accident remedial measures	Road user charging	Pedestrian areas & routes	Land use to support public transport	32
3	Development density and mix	Cycle networks	Accident remedial measures	Road user charging	Land use to support public transport	31
4	Accident remedial measures	Intelligent transport systems	Road user charging	Pedestrian areas & routes	Land use to support public transport	31
5	Accident remedial measures	Regulatory restrictions	Road user charging	Pedestrian areas & routes	Land use to support public transport	31
6	Development density and mix	Cycle networks	Accident remedial measures	Road user charging	Pedestrian areas & routes	30
7	Development density and mix	Accident remedial measures	Intelligent transport systems	Road user charging	Land use to support public transport	30
8	Accident remedial measures	Parking controls	Road user charging	Pedestrian areas & routes	Land use to support public transport	30
9	Cycle networks	Accident remedial measures	Regulatory restrictions	Road user charging	Pedestrian areas & routes	30
10	Development density and mix	Cycle networks	Road user charging	Pedestrian areas & routes	Land use to support public transport	30
11	Accident remedial measures	Urban traffic control	Road user charging	Pedestrian areas & routes	Land use to support public transport	30
12	Cycle networks	Accident remedial measures	Intelligent transport systems	Road user charging	Land use to support public transport	30

# CONCLUSION

## POLICY MEASURES:

- **Cycle Network:** A Cycle Network provides the framework for a series of cycle infrastructure interventions and improvements covering a given area or city and can incorporate: a network of Cycle Routes incorporating Segregated cycle facilities, provision of Cycle parking and storage; and integration of cycling with public transport. In addition to encouraging more people to cycle, so helping to reduce congestion and pollution, the implementation of a Cycle Network with carefully designed infrastructure can improve cyclist safety. Further potential benefits of cycling include greater opportunities for social interaction and reduced cyclist/pedestrian conflict, resulting in more liveable streets
- **Accidental remedial measures:** Speed limitation can be introduced by legal and/or physical measures. Enforcement of speed limits uses a combination of stationary and mobile methods. The former tend to take the form of ‘speed cameras’ and allow violations of traffic regulations to be detected. Road markings are intended to give drivers reference points with regard to the proximity of their vehicle to other vehicles and the road. Delineator posts and distance markings on motorways, and raised pavement markers can all be used to direct traffic by indicating the path of the carriageway and warn road users about specific hazardous conditions related to the road alignment etc.
- **Road User charging:** Road user charging can reduce traffic levels in the affected area, typically by 15% to 20%, with more substantial reductions in congestion. Key issues with road charging are its acceptability to drivers (and to others who may be affected by it, e.g. businesses within the charged area), the type and complexity of the chosen technology (manual, video-based, fully electronic), and enforcement.
- **Pedestrian Areas and Routes:** People need to walk. Walking is the mode that is always used as part of any journey whether they are car based trips or otherwise. Practitioners need to understand how to improve the management of the interrelation between public space, transport network and social, legal and political context in order to influence pedestrian behaviour and to provide safe and attractive pedestrian areas. Creating good urban spaces requires knowledge of the walking characteristics and pedestrians’ needs, abilities and desires.
- **Land Use to Support Public Transport:** Encouraging public transport use through land use planning involves the planning of new land development and the management of existing land in such a way as to:
  - ❑ Improve conditions for the efficient operation of public transport,
  - ❑ Improve the accessibility of urban areas and enable people to travel more by alternative modes,
  - ❑ Increase the demand for public transport, particularly by encouraging mode change from the private car.

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- Population, build up area and build up area per capita using World cities tool <http://www.worldcitiestool.org/>.
- Information about the methodology, the sources and other details for the datasets visible in this tab can be found in the document Description of the GHS Urban Centre Database 2015.
- The Decision Makers' Guidebook complements the European Commission's more recent guidance on the development of Sustainable Urban Mobility Plans.
- Measure Option generator, policy and decision makers guidance <http://www.konsult.leeds.ac.uk/mog/>.